A FEASIBILITY STUDY ON THE SEISMIC RESPONSE OF SELECT NANOPARTICLES IN SATURATED GRANULAR MEDIA

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As engineered nanomaterials become more prevalent, environmental releases of nanoparticles likewise increase. The environmental and human health impacts of these engineered nanoparticles are largely unknown. Currently, there are no proven methods of detecting their fate and transport in the subsurface. For this reason, new testing and detection techniques are being explored.

This research is part of the U.S. EPA National Exposure Research Laboratory (NERL) broad effort to conduct studies on the effects of engineered nanoparticles on ecosystems and human health. The seismic characteristics are used to establish defining features of select nanoparticles in saturated granular media. A bench-scale seismic testing apparatus is designed, built and optimized for measuring the seismic signatures of varying concentrations of engineered nanoparticles in saturated granular media. The ultimate goal of this research is to test the seismic method as a feasible approach to detecting nanoparticles in the subsurface under optimal conditions, while establishing the concentration detection limit for this method.

By actuating piezoceramic bender elements mounted inside a test column, shear and compression waves are generated and received through the saturated granular media within the column. The column system is initially calibrated in air and water. The column is then filled with granular media and saturated with water. The seismic signature for this set of parameters establishes the baseline. Tests are then repeated with various nanoparticle dispersions. The dispersions to be tested include nano titanium dioxide, nano zinc oxide, nano silver, and nano zero valent iron. The seismic responses are to be analyzed for variances in travel time, amplitude and spectral content with respect to nanoparticle concentration. It is anticipated that the results will be applied to plot a "breakthrough curve" (BTC) of seismic response with respect to nanoparticle concentration levels. This BTC would reveal the nanoparticle concentration seismic detection point. The preliminary results of this research will guide future experiments investigating the utility of seismic methods in nanoparticle fate and transport studies.